

REMARKS/ARGUMENTS

Applicants wish to thank the Examiner for the careful review of the claims, specification and drawings.

Claims

Claims 1-34, 37, 40, and 43 have been canceled.

Independent claims 35 and 45 have been amended.

After entry of this amendment, claims 35, 36, 38, 39, 41, 42, and 44-50 are pending.

It is respectfully submitted that each and every feature recited in the pending claims are fully supported in the specification as filed. No new subject matter has been added.

Rejections under 35 USC § 112

The Office Action argues that claims 35-36, 38-39, 41-42 and 44-50 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, the Office Action argues that in these claims the limitations "at least a start point of the at least one time range is delayed relative to at least a start point of the at least one time duration" in claim 35 and the limitation "the time window being less than the at least one time duration" in claim 45 and claim 36 are not understood. The Office Action also argues that in these claims specifically the phrase "for the at least one time duration" is not understood.

Applicants hereby amend independent claims 35 and 45, as follows:

35. (Currently amended) A method for determining an endpoint indicator in plasma processing, the method comprising:

providing a signal having a frequency;

etching, in a plasma processing chamber, at least one sample substrate using the signal;

determining at least one calibrating endpoint by performing an empirical analysis on the at least one sample substrate;

etching, in the plasma processing chamber, at least one test substrate using one or more signals having the frequency, the at least one test substrate being etched ~~for over~~ at least one time duration, the at least one time duration including beyond the at least one calibrating endpoint;

measuring a plurality of parameters over at least one time range ~~when etching the at least one test substrate~~, the at least one time range including the at least one calibrating endpoint, ~~at least a start point of the at least one time range is delayed relative to at least started later than~~ a start point of the at least one time duration;

comparing data pertaining to at least a plurality of harmonics for the plurality of parameters, the plurality of harmonics representing harmonics of the frequency, the data pertaining to at least sensitivity of the plurality of harmonics for the plurality of parameters responsive to the at least one calibrating endpoint; and

selecting the endpoint indicator based on the comparing, the endpoint indicator including a selected harmonic for a select parameter of said plurality of parameters.

45. (Currently amended) A method for detecting an endpoint in plasma processing that employs a signal having a frequency, the method comprising:

etching at least one sample substrate using at least one signal having the frequency;
determining a calibrating endpoint by performing an empirical analysis on at least one etched location of the at least one sample substrate;

etching at least one test substrate using one or more signals having the frequency, the at least one test substrate being etched ~~for over~~ at least one time duration, the at least one time duration including beyond the calibrating endpoint;

measuring a plurality of parameters over a time range when processing the at least one test substrate, the time range including the calibrating endpoint;

comparing data pertaining to a plurality of harmonics of the frequency for the plurality of parameters, the data pertaining to the calibrating endpoint;

selecting a harmonic of the frequency for a parameter from the plurality of harmonics of the frequency for the plurality of parameters as an endpoint indicator based on the comparing, wherein a signal representing the harmonic of the frequency for the parameter is selected from a plurality of signals representing the plurality of harmonics of the frequency

for the plurality of parameters as having the most repeatable response pertaining to the calibrating end point;

setting at least one criterion pertaining to the harmonic of the frequency for the parameter for indicating the endpoint;

etching a production substrate at the frequency;

determining a time window around an expected endpoint, the expected endpoint determined based on the calibrating endpoint, a length of the time window being less than a length of the at least one time duration;

monitoring the harmonic of the frequency for the parameter within the time window when etching the production substrate; and

signaling the endpoint when the at least one criterion is met.

For clarification, the limitations that the Office Action argues to be not understood have been amended. It is respectfully submitted that the amended claims 35 and 45 as well as associated dependent claims are definite to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Accordingly, it is respectfully requested that the rejections under 35 U.S.C. 112, second paragraph, be removed.

No new limitation has been added. No new subject matter has been added.

Rejections under 35 USC § 102

The Office Action rejected claims 35-36, 39, 41, 44-48, and 50 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Turner et al. (US 5576629), hereinafter “Turner”.

The Office Action rejected claims 35-36, 39, 41-42 and 44-50 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Butler et al. (US 5458732), hereinafter “Butler”.

The Office Action rejected claims 35-36, 39, 41, 44-48 and 50 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Miyashita et al. (JP 08227875), hereinafter “Miyashita”.

Reconsideration of the rejections is respectfully requested.

Each of independent claims 35 and 45 of this application includes the limitation/feature of comparing data pertaining to a plurality of harmonics of a frequency for a plurality of parameters. Each of the independent claims 35 and 45 also includes the limitation/feature of selecting a harmonic of the frequency for a parameter from the plurality of harmonics of the frequency for the plurality of parameters as an endpoint indicator based on the comparing. Claim 35 further requires that the comparing and selecting are based on sensitivity of the harmonics responsive to at least one calibrating endpoint. Claim 45 further requires that the selecting is based on repeatability of responses pertaining to at least one calibrating end point.

In contrast, none of Turner, Butler, and Miyashita teaches comparing harmonics of a frequency for parameters and selecting a harmonic of the frequency for a parameter as an endpoint indicator based on sensitivity or repeatability.

Turner teaches that by sensing harmonic values for voltage, current, and phase angle of the radio frequency power, it is possible to detect and control shifts in these radio frequency power parameters to even more precisely control the generation of radio frequency power during the plasma process (col. 5, lines 5-9). Turner also teaches a closed loop automatic gain control feature for controlling voltage, current, and/or phase so that voltage, current, and/or phase angle signals are measurable and used for process control (col. 5, lines 9-14). Nevertheless, Turner does not teach the comparing and selecting required by each of claims 35 and 45 in this application. Turner mentioned repeatability of the endpoint signal (e.g., col. 18, lines 12-19), but does not teach selecting a signal that has the most repeatable response pertaining to a calibrating end point as the endpoint indicator.

Butler teaches that the chamber condition changes may be seen in the harmonics but not in the fundamental electrical signal (col. 3, lines 51-63). Butler also teaches that an electrical characteristic is monitored at at least one associated frequency different from a fundamental frequency and that the electrical characteristic is chosen from the group consisting of power, phase, RMS voltage, RMS current, peak-to-peak voltage, peak-to-peak current, and impedance (Butler's claims 1 and 10, Abstract). Nevertheless, Butler does not teach comparing harmonics of a frequency for parameters and selecting a harmonic of the frequency for a parameter as an endpoint indicator based on sensitivity (required by claim 35 of this application) or repeatability (required by claim 45 of this application).

Miyashita also fails to teach comparing harmonics of a frequency for parameters and selecting a harmonic of the frequency for a parameter as an endpoint indicator based on sensitivity (required by claim 35 of this application) or repeatability (required by claim 45 of this application).

Claim 35 of this application also requires measuring a plurality of parameters over at least one time range, which is started later than a start point of at least one time duration for etching at least one test substrate.

In contrast, Turner, Butler, and Miyashita fail to teach test substrates. Turner, Butler, and Miyashita also fail to teach starting measuring parameters later than starting etching test substrates.

Claim 45 of this application also requires monitoring a selected endpoint indicator within a time window, wherein the length of the time window is less than the length of at least one test-substrate-etching time duration.

In contrast, Turner, Butler, and Miyashita fail to teach test substrates. Turner, Butler, and Miyashita also fail to teach a time window with a length that is less than the length of at least one test-substrate-etching time duration. Turner, Butler, and Miyashita teach monitoring during etching without suggesting any reduced time window.

For the aforementioned reasons and others, it is respectfully submitted that claims 35 and 45 as clarified are novel, non-obvious, and patentable over the cited arts of records, taken alone or in combination.

It is also respectfully submitted that claims 36, 39, 41, 44, 46-48, and 50 which depend from at least one of the amended claims 35 and 45 also are novel, nonobvious, and patentable not only due to their recitations of independently patentable features but also due to their dependence from at least one of the patentable parent claims 35 and 45.

No new limitation has been added. No new subject matter has been added.

Rejections under 35 USC § 103

The Office Action rejected claims 38 under 35 U.S.C. 103(a) as being unpatentable over Turner in view of Kagoshima et al. (US Pub 2003/0003607), hereinafter “Kagoshima”.

The Office Action rejected claims 42 and 49 under 35 U.S.C. 103(a) as being unpatentable over Turner in view of Butler.

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It is respectfully submitted that claims 38, 42, and 49 which depend from at least one of claims 35 and 45 also are novel, nonobvious, and patentable not only due to their recitations of independently patentable features but also due to their dependence from at least one of the patentable parent claims 35 and 45.

No new limitation has been added. No new subject matter has been added.

CONCLUSION

In view of the discussion herein, Applicant(s) believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at 408-213-9540.

If any additional petition is required to facilitate the entry of the present amendment, please consider this communication a petition therefore as well. The Commissioner is authorized to charge any fees beyond the amount enclosed which may be required, or to credit any overpayment, to Deposit Account No. 50-2284 (Order No.LMRX-P037).

Respectfully submitted,
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